PB-215 570

QUARTERLY RESEARCH REPORT - JANUARY 1-MARCH 31, 1970, ALASKA WATER LABORATORY, COLLEGE, ALASKA

Federal Water Pollution Control Administration
College, Alaska

31 March 1970

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UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
ALASKA WATER LABORATORY

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QUARTERLY RESEARCH REPORT

JANUARY 1 — MARCH 31
1970

ALASKA WATER LABORATORY
College, Alaska 99701

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ALASKA WATER LABORATORY

The Laboratory has been the site of a series of meetings during the quarter with representatives of the oil industry, equipment manufacturers, staff of the Alaska Water Laboratory and Arctic Health Research Center, and representatives of the Alaska Department of Health and Welfare, concerning waste treatment needs on the North Slope. Progress is being made in the education process of both the equipment manufacturers and oil industry personnel. One important outcome of these meetings has been several inquiries on the research, development and demonstration grant program. We expect to see one or more good grant applications come out of these associations.

The Alaska Water Laboratory has made an agreement with the Institute of Marine Sciences of the University of Alaska, to use the AWL's facilities for the housing and utilization of their Ultraviolet Organic Carbon Recovery Unit. This agreement was made in accordance with the Alaska Water Laboratory's policy to make the Laboratory more available to qualified university scientists when there is a direct relationship between this use and the Laboratory research mission.

The Laboratory reviewed and commented on a research proposal entitled "Investigations on Possible Effects of Crude Oil on Aquatic Organisms of the Central Alaskan Fisheries." Two other proposals are currently under review and will be completed in April.

Preparations are being made to present two FWPCA training courses at the Laboratory. "Survey of Chemical Analyses for Water Quality," and "Survey of Current Practices in Water Microbiology" will be presented April 13-17, 1970, and April 20-24, 1970, respectively. This is the first time either course has been offered in Alaska and a heavy enrollment is expected.

WATER QUALITY SECTION

PROJECT: SAGAVANIRKTOK RIVER BASIN STUDY:

Objectives:

To provide baseline water quality information on the Sagavanirktok River system and the immediate industrial region of the developing oil field.

Work Accomplished Third Quarter FY 1970:

Microbiological, aquatic biology, and chemical samples from both the June and August trips, except for the final taxonomy of the diatoms and certain of the aquatic insects, have been assayed and tabulated. As soon as the winter sampling data is available, the manuscript will be completed.

Fourth Quarter FY 1970 Work Plan:

Complete the third and final sampling trip in late April. Complete the manuscript for publication. The team for the final sampling trip will include an aquatic biologist from the Alaska Water Laboratory, a chemist from our Operations Office in Anchorage, and a representative for the United States Geological Survey. To provide the additional basic data that the Operations Office needs for the Trans-Alaska Pipeline evaluation, the team will continue the sample collection south to the Yukon River crossing. Samples will be analyzed for chemical and bacteriological parameters.

PROJECT: BACTERIAL QUALITY OF ALASKA WATER; I. COLIFORM CONTENT OF ALASKA WATER:

Objectives:

1. To obtain from all sources, the accumulated coliform data for the past three years.

2. To separate the information into surface water data and ground water data.

3. To sort the data into geographical categories, particularly with reference to streams and centers of population, and compile the information in a suitable form.

4. To prepare a summary and evaluation of the data and the information it presents.

Work Accomplished Third Quarter FY 1970:

The scattered laboratory data on the coliform content of Alaska water have been collected and sorted into surface and ground-water categories. This data has now been separated into geographical divisions with special reference to streams and centers of population. The tabulated material will be mimeographed and distributed to the FWPCA and State health workers.

Fourth Quarter FY 1970 Work Plan:

Complete analysis of data and organize all of the material for publication.

PROJECT: BACTERIAL QUALITY OF ALASKA WATER; II. DIE-OFF RATE OF ENTERIC INDICATOR BACTERIA IN A SUBARCTIC ALASKAN RIVER:

Objectives:

The objectives of this study of the Tanana River from its confluence with the Chena River to its confluence with the Yukon River are as follows:

1. To determine the rate of reduction in numbers of fecal indicator bacteria.

2. To determine changes in the chemical parameters which are associated with domestic wastes.

3. To establish the time required for a water mass to travel from the mouth of the Chena River to the mouth of the Tanana River.

Work Accomplished During Third Quarter FY 1970:

The collection of field data was done during the two-week period of February 23, 1970, to March 5, 1970. Tabulation of the bacteriological data on the total coliforms, fecal coliforms, and enterococci is completed and suggest that there is a fairly high degree of survival of these organisms after the approximately 8 days of flow time through the 200+ miles of river under study. Actual die-off rate analysis cannot be made until the results of the discharge measurements and dye study, done by the U.S. Geological Survey personnel during the study, are completed. The role of chemical parameters are also awaiting completion of analysis.

Numerous problems were encountered in the field. They were mainly bad flying weather, icing of equipment, freezing of some samples, and -75° to -100° F chill factors at some of the sampling stations. Because of the conditions encountered, a side benefit of debugging field gear, which will be used on the extended field trip to the North Slope oil field next month, was possible.

The amount of work generated by this study required a concentrated team effort by numerous Laboratory personnel working many extra hours and odd hours to handle the samples each day.

Fourth Quarter FY 1970 Work Plan:

As soon as all of the results are received, writeup will begin. The paper should be finished by the end of the quarter.

PROJECT: SIGNIFICANCE OF WINTER DISSOLVED OXYGEN IN ALASKA:

Objectives:

1. To determine the extent and significance of the dissolved oxygen reduction in arctic and subarctic streams under winter conditions.

2. To determine the effects of the lowered dissolved oxygen levels on the aquatic organisms while under simulated arctic or subarctic conditions.

Work Accomplished Third Quarter FY 1970:

The collection of winter dissolved oxygen data from the Chena, Chatanika, and Salcha Rivers continued. The level of dissolved oxygen ranged from 1.0 mg/l in the Chena River on February 16, to the high of 9.1 in the Chatanika River, at the Steese Highway bridge, on January 21. In general, the Chatanika and Salcha Rivers exhibited similar oxygen reductions but at a higher percent of saturation than the Chena River. Last quarter, the Chatanika and Salcha Rivers hovered in the 9 to 10 mg/l range but the level dropped to 6.8 in the Salcha and 9.1 in the Chatanika. In the third quarter 1970, the waters of the Chena underwent a dissolved oxygen reduction of nearly 4.5 mg/l at Station 600. The level fell from an average of 8. to about 3.5. In the Lower Chena River, Station 100, the oxygen levels were reduced from values

slightly greater than 5 in December to under 3 in January and February.

Routine checking of the Living Stream system for problem areas continued. The refrigeration system was monitored for variation and reliability. Two fully functional systems were made operational and checked for leaks. Five species of fish were collected from the Chena River and placed in the tanks to determine the unsuitabilityfor fish study. Observations were made on the size limitations of the fish that can be used. The charcoal filter system was activated to observe the effectiveness in purifying the circulated water, as well as determine the "load" that the filter can handle. Observations were made on the suitability of commercial food for feeding the different species of fish while in the holding tanks.

Fourth Quarter FY 1970 Work Plan:

Continue the field work to document the dissolved oxygen trends in the selected streams. Continue working with the Living Stream system to determine the working capability and limitations of the system.

PROJECT: THE ROLE OF MICROORGANISMS AT LOW TEMPERATURES IN ALASKA RIVERS:

Objectives:

1. Determine the rate and extent of oxygen consumption by the mixed bacterial population in a subarctic stream at 0°, 5°, 10°, 15° and 20°C, using laboratory substrates.

2. Determine the rate and extent of oxygen consumption by the mixed bacterial population in a subarctic stream at 0°, 5°, 10°, 15° and 20°C, using domestic sewage effluent which has received various degrees of treatment as the substrate.

3. Determine if there is a relationship between (2) size and composition of the bacterial population, (b) type and amount of substrate available, (c) natural environmental characteristics, and oxygen consumption at each temperature.

Work Accomplished During Third Quarter FY 1970:

It has been necessary to stop work on the selection of a complex medium for plate counts to enable more rapid progress on the oxygen depletion portion of this study.

The metabolic study involving the rate and extend of oxygen utilization by microorganisms using laboratory substrates has been accepted for presentation at the Symposium on Water Pollution Control in Cold Climates to be held in Fairbanks during late July

1970. Work on this portion of the project is continuing at an accelerated pace in order to have the results ready for presentation. A method of aerating and adjusting the temperature of the river water, plus substrate to the desired incubation temperature before distribution into BOD bottles has been devised. This makes it possible to have better control of the experimental conditions when comparing oxygen depletion of one substrate at several incubation temperatures, several substrates at one incubation temperature and between water samples. As previously noted, a mixture of amino acids gave the most rapid rate of oxygen depletion. The rate limiting effect of the amount of the amino acid mixture was determined and 120 mg/l of river water was found to be enough to remove the limiting effect of the substrate on the rate of oxygen depletion. When this amount of substrate was utilized at the incubation temperatures between 0° and 20°C, the 20°C incubation temperature was found to give a shorter lag phase before the start of oxygen depletion than the 15°C incubation temperatures. This is in contrast to the earlier findings that the lag phase was the same at 15° and 20°C, using a lower amount of the amino acid substrate. Glucose was previously found to be poorly utilized as a substrate for oxygen depletion by the microflora in the river. Work just completed has shown that either added nitrogen or phosphorus has

a small effect on the rate of oxygen utilization with glucose as the substrate and that a mixture of nitrogen and phosphorus increases the rate nearly equal to that found with the amino acid mixture.

Fourth Quarter FY 1970 Work Plan:

The detailed work on oxygen consumption by the microflora in a subarctic river will be completed. A very brief study using samples from an arctic river will be done to compare the two rivers.

Write-up of the results for presentation will be completed on or about June 15, 1970.

WASTE TREATMENT SECTION

PROJECT: ALASKA APPLICATION OF WASTE STABILIZATION LAGOON:

Objectives:

To demonstrate the feasibility of waste stabilization lagoon application in Alaska, particularly utilizing winter storage and summer treatment capabilities. To develop design criteria for setting loadings, for operational schemes, etc. To investigate materials utilization and other design factors to minimize costs.

Work Completed Third Quarter FY 1970:

The lagoon has been freezing solid during filling operations (approximately 5/7" liquid/day). During warmer weather in March, leakage started. Thermal expansion of ice from -30° to +30°F is thought to have cracked the 24" reinforced concrete lining.

Work Plan Fourth Quarter FY 1970:

1. Pump down the lagoon as soon as the ice melts to determine the failure mode and begin repairs.

2. Initiate studies on the Ft. Yukon, Alaska, stabilization pond, which has a population equivalent of 63 and a spring surface area of 1/2 acre. The lagoon is located 8 miles north of the Arctic Circle.

3. Define sludge accumulation and bacteriology.

4. Study algal effects and compare with aerated lagoons.

PROJECT: COLD REGIONS AERATED LAGOON:

Objectives:

To establish design criteria for the aerated lagoon waste treatment process in Alaska. Design criteria will include operational efficiency versus loading, evaluation of construction methods, evaluation of types of feasible equipment, and process modifications to provide more efficient plant utilization. To evaluate parameters and contribution to effluent quality, power and maintenance costs, and reliability.

Work Completed Third Quarter FY 1970:

HCl gas cleaning and evaluation of the Hinde tubing has been completed. An aeration system, utilizing one type disc diffusers (Aer-o-flo), has been installed and is being evaluated. A sampling trip was made to the Northway aerated lagoon on March 30.

A report entitled "Research on Multi-cell Sub-Arctic Aerated Lagoons" is in preparation. It will include data from the Eielson Air Force Base and Northway lagoons.

The Eielson lagoon is being converted from a six cell to a four cell system.

Work Plan Fourth Quarter FY 1970:

1. Evaluate a four cell system and compare to a six cell system.

2. Complete report "Research on Multi-cell Sub-Arctic Aerated Lagoons."

3. Initiate studies upon algal effects and compare with s stabilization ponds.

4. Define sludge accumulation problems and bacteriology.

PROJECT: ALASKA EXTENDED AERATION:

Objective:

Development of adequate design criteria for application of extended aeration in Alaska.

Work Completed Third Quarter FY 1970:

Operation of the extended aeration basin at Eielson Air Force Base was terminated in January. Heavy sludge accumulations under the tube settler module hoppers blocked solids return to the system. The resulting heavy solids concentration in the effluent plugged the effluent lines. In an attempt to keep the settling tube overflow rates low, the influent flow rate was reduced and the total BOD load maintained at a high level by feeding primary sludge to the system. Extensive surface icing occurred under these conditions with over 90 percent of the MLSS becoming entrained in the ice.

Two model tube settler reactors have been fabricated to study the problems encountered with the extended aeration basin and to define the settling characteristics of tube settlers of various sizes. One of the models has been operated at a 12-hour detention time for 5 weeks with studies on the influences of temperature changes through a range of 0.5°C to 8°C being conducted. Bio-kinetic data and settling information at various overflow rates has been collected.

Constant reactor temperatures of 0.5°C and 4°C resulted in stable operation; whereas, operation at 8°C resulted in a bulking sludge which passed in the effluent at very low loading rates. The reactor temperature has been dropped to less than 1°C again and the feed cut off, in an attempt to stop the sludge bulking.

The second reactor has been placed in operation and is expected to stabilize within 2-3 weeks for data collection.

Work Plan Fourth Quarter FY 1970:

1. Continue laboratory tests to define the settling characteristics of tube settlers of various sizes.

2. Continue laboratory tests to determine the influences of temperature changes on a 12-hour and 24-hour detention time extended aeration system for the ranges of .5°C to 12°C.

3. Attempt to define the sludge bulking problem which occurs at temperatures around 8°C.

4. Further define the surface icing phenomena through laboratory testing.

5. Determine the effects on DO transfer of extremely low air temperatures used in aeration.

CONSOLIDATED LABORATORY SERVICES

Work Accomplished Third Quarter FY 1970:

A comprehensive computer program is being developed for handling all laboratory data, to serve as a review of computations by staff and a storage and processing system. Because of the limitations of staff, progress is made slowly.

Final editing was completed for STORET of all data collected and analyzed for the pipeline and North Slope studies during 1969.

Analysis of samples from the cold room reactor systems and the Eielson aerated lagoon is being continued. Of particular concern are COD, BOD, solids, and nutrients.

Samples were analyzed in connection with the study of die-off rate of bacteria in low temperatures. Analysis for nutrients has yet to be completed.

Work Plan Fourth Quarter FY 1970:

Projects are currently planned in which Consolidated Laboratory Services will be participating include:

1. Bering River Survey (Operations).
2. Pipeline Study (Operations).
3. Forest Service Fertilization Project (Operations).
4. Sagavanirktok River Basin Study (Research).
5. Waste Treatment pilot plant and bench scale sample analysis (Research).

PUBLICATIONS AND PRESENTATIONS

Richard W. Latimer presented material on arctic and subarctic environmental conditions affecting water pollution control to State officials on January 5, 1970.

Ernst W. Mueller spoke before the 16th Annual Conservation and Resource Management Course conducted by the University of Alaska, Cooperative Wildlife Research Unit, on Alaska's waters and water pollution.

Ernst W. Mueller also spoke before the Oceanography 693 class at the University of Alaska on "Biology and Chemistry of Arctic Rivers."

A research report "Effects of Forest Fires on Water Quality in Interior Alaska," by Frederick B. Lotspeich, Ernst W. Mueller, and Paul Frey, has been published and is being readied for distribution.

Frederick B. Lotspeich prepared a short paper entitled "Industrial Development and Environmental Protection in Arctic Alaska" to be published in Marine Pollution Bulletin.

The Alaska Water Laboratory, collaborating with the Arctic Health Research Center and the State Department of Health and Welfare, has been invited to publish a series of monthly articles in the "Arctic Oil Journal" starting in May 1970.

Alaska Water Laboratory Seminars:

January 9	Joe Holty, "Air Quality in Fairbanks-Ice Fog"
January 23	Jerry Hok, "Lasting Effects of Tracked Vehicles on the Arctic Tundra"
February 6	Daniel Hawkins, "Radioactive Wastes"
February 20	Conrad Christianson, "Activated Sludge at Low Temperatures"
March 20	Bob Krumm, "Environmental Guidelines Associated With Oil Activities"

TRAVEL

Ernst W. Mueller went to the Pacific Northwest Water Laboratory in Corvallis, Oregon, to confer with the staff of the Consolidated Laboratory there.

Richard W. Latimer and Sidney E. Clark went to Washington, D.C., for 1600 Research Program review.

VISITORS TO THE ALASKA WATER LABORATORY

Vi Visitors to the Alaska Water Laboratory during this quarter were: Mr. James L. Agee, Northwest Regional Director, Mr. Oscar Dickason, Director, Alaska Operations Office in Anchorage, and Mr. Keith Stewart, Aquatic Biologist, also from the Alaska Operations Office.

PUBLIC RELATIONS

The Alaska Water Laboratory's FWPCA display was completed and was set up in the Capitol Building in Juneau where it can be viewed by the State legislators, who are now in session, and by the general public. In the future, this display will be moved from city to city throughout the state for public viewing.

Tours of the Laboratory facilities were given to 100 high school science students and several college students during the quarter.

Three-hundred, thirty-seven copies of F. B. Lotspeich's reprint "Water Pollution in Alaska: Present and Future" (Science, December 1969), were requested and sent.

Twenty-three copies of the publication "Practice of Water Pollution Biology" were asked for and mailed.

Eleven copies of the publication "Ecological Changes in the Chena River," and four copies of the report "Effects of Placer Mining on Water Quality in Alaska" were requested and mailed. Both are Alaska Water Laboratory publications.